REMARKS

Upon entry of this amendment, claims 1, 2, 5, 7, 8-11, 13-15, 21, 23, and 26-28 will be pending in the application. By this amendment, claims 1, 2, 13, 21, and 26 are amended and claims 27 and 28 are added for the Examiner's consideration. Claims 3, 4, 6, 12, 16-20, 22, 24, and 25 are canceled without prejudice or disclaimer. The above amendments and new claims do not add new matter to the application and are fully supported by the original disclosure. For example, support for the amendments and new claims is provided in the claims as originally filed, at Figures 6a-c, and at page 9 of the specification. Reconsideration of the rejected claims in view of the above amendments and the following remarks is respectfully requested.

Amendment is Proper for Entry

Applicants submit that the instant amendment is proper for entry because the amendment places the application in condition for allowance. More specifically, the independent claims are amended to recite combinations of features not disclosed or suggest by the prior art of record. Moreover, as the subject matter of all of the pending claims has already been considered by the Examiner, Applicants submit that these amendments do not raise new issues that would require further search or consideration. For example, claim 1 is amended to substantially incorporate the features of claims 3, 4, 6, and 12. Moreover, independent claim 26 is amended to recite an ordering of the already recited method steps. For these reasons, Applicants submit that these amendments place the application in condition for allowance and do not raise new issues that would require further search and/or consideration

Alternatively, Applicants submit that the instant amendment places the application in better form for appeal by reducing the issues for appeal. Moreover, no new claims are added without canceling a corresponding number of claims.

Allowed Claims

Applicants appreciate the indication that claim 15 contains allowable subject matter. However, Applicants submit that all of the claims are in condition for allowance for the following reasons.

35 U.S.C. §103 Rejection

Claims 1-3, 5-8, 10-11, and 16 are rejected under 35 U.S.C. §103(a) for being unpatentable over U.S. Patent No. 4,415,375 ("Lederich") in view of U.S. Patent No. 2,892,742 ("Zwicker") and U.S. Patent No. 1,360,358 ("Beall").

Claim 4 is rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich, Beall, and Zwicker, and further in view of and U.S. Patent No. 4,505,764 ("Smickley").

Claim 9 is rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich, Beall, and Zwicker, and further in view of and U.S. Patent No. 4,902,535 ("Garg").

Claims 12-13 are rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich Beall, and Zwicker, and further in view of and U.S. Patent No. 5,211,775 ("Fisher").

Claim 14 is rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich and Beall, Zwicker, and Fisher, and further in view of and U.S. Patent No. 2,974,021 ("Borowik").

Claims 17-20 are rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich Beall, and Zwicker, and further in view of U.S. Pat. No. 4,512,826 ("Whang").

Claim 25 is rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich, Beall, and Zwicker, and Whang, and further in view of and U.S. Pub. No. 2002/0033717 ("Matsuo").

Claims 21-24 are rejected under 35 U.S.C. §103(a) for being unpatentable over Matsuo.

Claim 26 is rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich in view of Beall and Fisher.

These rejections are respectfully traversed.

Claims 1-3, 5-8, 10-11, and 16 in view of Lederich, Zwicker, and Beall

The present invention relates to a method for machining a workpiece made from a titanium based alloy. More specifically, independent claim 1 is amended to recite:

> 1. A method for machining a workpiece made from a titanium-based alloy, comprising:
> removing at least one of surface oxides and further covering layers from regions of the workpiece;
> heating the workpiece to an annealing temperature of approximately 973 K in a hydrogen-containing atmosphere, wherein the workpiece takes up hydrogen, and wherein the hydrogen containing atmosphere is under a pressure of approximately 5×10^3 Pa;
> cooling the workpiece in the hydrogen-containing atmosphere;
> metal-removing machining the workpiece; and
> heating the workpiece in a hydrogen-free atmosphere, wherein hydrogen is released.

Applicants submit that no proper combination of the applied art renders claim 1 obvious. Particularly, Applicants submit that no proper combination of the applied art teaches the combination including, inter alia, *cooling the workpiece in the hydrogen-containing atmosphere; metal-removing machining the workpiece; and heating the workpiece in a hydrogen-free atmosphere, wherein hydrogen is released.*

Applicants acknowledge Lederich discloses heating a Ti-6Al-4V alloy to add hydrogen, and subsequently heating the alloy in a vacuum to release the added hydrogen. However, Lederich does not disclose *cooling the workpiece in the hydrogen-containing atmosphere*, or *metal-removing machining the workpiece*. Nor would it have been obvious to modify Lederich to include these steps.

Lederich does not disclose *cooling the workpiece in the hydrogen-containing atmosphere*, as recited in claim 1. Instead, Lederich discloses a method of superplastic forming of titanium alloys. The Examiner acknowledges that Lederich does not specifically teach cooling, but contends that it is inherent that the workpiece will be cooled before it is employed for its

application. However, claim 1, as amended, recites cooling the workpiece *in the hydrogen containing atmosphere.* Lederich teaches adding hydrogen to the alloy before the superplastic forming and releasing hydrogen from the alloy after the superplastic forming. More specifically, in each of the embodiments using titanium alloy, Lederich discloses heating the alloy to a first temperature in a pressurized atmosphere to add hydrogen, heating the alloy to a second temperature (higher than the first) to superplastic-form the alloy, and then heating the alloy to a third temperature in a vacuum to release hydrogen. However, Lederich makes no mention whatsoever of *cooling the workpiece in the hydrogen-containing atmosphere.*

Moreover, Applicant submit that a step of *cooling the workpiece in the hydrogen-containing atmosphere* is not inherent in the process of Lederich. The Examiner seemingly contends that a cooling step is inherent in any process when the workpiece is removed from the furnace after all operations are concluded, e.g., when the workpiece is cooled in an ambient atmosphere before being used for its application. Without acquiescing in the veracity of this assertion, Applicants note that claim 1 has been amended to recite cooling the workpiece *in the hydrogen-containing atmosphere*. Thus, the Examiner's interpretation of inherent cooling in an ambient atmosphere is in applicable to the claimed invention as amended.

Zwicker does not cure the deficiencies of Lederich because Zwicker also fails to disclose or suggest *cooling the workpiece in the hydrogen-containing atmosphere.* Zwicker discloses that a sample "was additionally heated to 900 °C in hydrogen and permitted to cool in the oven" (col. 2, lines 41-43). This passage only states that the sample was cooled in the oven, but does not describe the atmosphere of the oven during the cooling. There is no way to tell from this statement whether the oven contained hydrogen or not while the sample was allowed to cool. The Examiner even acknowledges at page 13 of the Office Action that Zwicker does not teach that the hydrogen atmosphere is maintained during cooling. Therefore, no proper combination of the

applied art teaches *the workpiece is cooled in the hydrogen-containing atmosphere*, as recited in claim 1.

Furthermore, Applicants disagree with the Examiner's conclusion that it would have been obvious that the hydrogen-containing atmosphere in Zwicker be maintained during cooling, and note that this assertion is not factually supported.[1] The Examiner has not pointed to any evidence of the record to support this assertion. Instead, this assertion appears to be mere speculation as to how the Zwicker system might operate. However, rejections based on §103 must rest on a factual basis with these facts being interpreted without hindsight reconstruction of the invention from the prior art. The Office may not, because of doubt that the invention is patentable, resort to speculation, unfounded assumption or hindsight reconstruction to supply deficiencies in the factual basis for the rejection. *See, In re Warner*, 379 F.2d 1011, 1017, 154 USPQ 173, 177 (CCPA 1967), *cert. denied*, 389 U.S. 1057 (1968). The Court of Appeals for the Federal Circuit has repeatedly cautioned against employing hindsight by using a patent applicant's disclosure as a blueprint to reconstruct the claimed invention from the isolated teachings of the prior art. *See, e.g., Grain Processing Corp. v. American Maize-Prods. Co.*, 840 F.2d 902, 907, 5 USPQ2d 1788, 1792 (Fed. Cir. 1988).

Moreover, even assuming for argument sake that Zwicker does teach *cooling the workpiece in the hydrogen-containing atmosphere* (which Applicants do not concede), it still would not have been obvious to add such a step to Lederich. As discussed above, Lederich is directed to a method of superplastic forming, in which the stock is raised to an even higher temperature after the hydrogen charging step so that the stock can slowly flow into the complex shape of the die. Thus, not only does Lederich teach away from cooling the workpiece in the

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[1] The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. See, MPEP §2142.

hydrogen-containing atmosphere, but adding such a cooling step in the hydrogen-containing atmosphere would render Lederich's process inoperable for its intended use. That is to say, cooling the stock in the hydrogen-containing atmosphere (instead of heating it to a higher temperature) would cause it to harden, such that it could not flow into the die. It is because of this reason that Lederich makes the temperature even higher in order to form the workpiece. Also, as the proposed modification would render the prior art invention unsatisfactory for its intended purpose, there is no suggestion or motivation to make the proposed modification. (See, *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984); MPEP §2143.01.) Therefore, there is no appropriate reason that would have prompted a skilled artisan to cool Lederich's workpiece in the hydrogen-containing atmosphere.

Applicants repeat and re-emphasize that the aim of Zwicker and Lederich is to improve the <u>deformability</u> of a workpiece, which is why they each disclose deforming a workpiece at a high temperature. In contrast, embodiments of the present invention aim to improve the <u>machining</u> of a workpiece made from TiAl6V4. The improved machining qualities of the workpiece allow higher cutting speeds to be achieved. Machining of a workpiece is generally performed at room temperature (it is unheard of, and likely impossible, to install a milling machine in an oven or furnace). Therefore, in embodiments of the invention the workpiece is cooled after the heating. More specifically, Applicants' specification states that "For cooling, the induction furnace is switched off and the workpiece is left to its own devices. When it has reached a temperature which allows further processing, the hydrogen-laden workpiece is subjected to metal-removing machining." (Specification, page 7.) This cooling step in embodiments of the invention is in direct contrast to the HELP-Effect (Hydrogen-Enhanced-Local-Plasticity) utilized by Lederich and Zwicker, which requires temperatures above 200° C.

Moreover, Applicants submit that one having ordinary skill in the art at the time the invention was made would not look to Zwicker for guidance to modify Lederich's invention. Zwicker is directed to a method for hot-working of titanium alloys, not superplastic forming. Zwicker teaches in Example 1 (the passage identified by the Examiner) that a titanium alloy is melted to add hydrogen, and then allowed to solidify. After solidification, the alloy is heated again and hot-worked (e.g., impacted with a 400 kg forging hammer). The process of Zwicker is so different from that of Lederich that the skilled artisan would have no reason to combine the teachings of the two. For example, Lederich does not disclose melting the alloy and then allowing it to solidify to add hydrogen; instead, Lederich teaches heating the alloy (below the melting point) in a pressurized hydrogen-containing atmosphere. Also, Lederich does not disclose hot-working (e.g., impacting with a forging hammer); instead, Lederich discloses superplastic forming in which the stock is heated to an elevated temperature and allowed to flow into a die shape. Therefore, the processes of Lederich and Zwicker are so different that one having ordinary skill in the art would not envisage a reason to combine the teachings of the two.

Beall does not cure the deficiencies of Lederich and Zwicker, because Beall also fails to disclose or teach cooling the workpiece. Instead, Beall only discloses die-pressing and machining, and makes no mention of heating or cooling.

In addition to failing to disclose cooling the workpiece in the hydrogen-containing atmosphere, Lederich also fails to disclose or suggest *metal-removing machining the workpiece*. As discussed above, Lederich is directed to a method of superplastic forming. Superplastic forming does not comprise or require metal-removing machining of a workpiece. Instead, superplastic forming is a known processing technique in which a sheet to be formed is placed in a die cavity. The sheet and tooling (e.g., die cavity) are heated, and a differential gas pressure is applied across the sheet by causing the gas pressure on one side of the sheet to be higher than the

gas pressure on the other side of the sheet. The differential gas pressure causes the heated sheet to plastically deform in to the shapes of the die cavity. For example, in discussing the differences between superplastic forming and other types of forming (e.g., casting, molding, forging, and machining), Lederich describes superplastic in the following manner:

> Titanium and titanium alloys are extremely valuable in uses where light weight and high strength to weight ratio are important. The aircraft industry and other transportation industries in particular find such alloys highly useful. In order to fully take advantage of the strength and weight properties of titanium, it is often desirable to utilize superplastic forming techniques, e.g., to form titanium and titanium alloys in complex parts. Complex parts are parts having a shape of such complexity that they cannot be readily formed by standard casting, molding, forging, machining and welding techniques.
>
> Superplastic forming typically is used to form sheet stock of between about 0.040 to 3/16 inch thickness. In superplastic forming, a die having the desired shape is used. A piece of stock of titanium alloy, such as a sheet of the alloy, is introduced into the die. The part is normally heated in the die. <u>In the die, the pressure on one side of the stock is reduced and the pressure on the other side of the stock is increased, for example, to between about 200-300 psi. The difference in pressure forces the stock to flow into the die and assume the desired shape conforming to the die</u>.
>
> (column 1, lines 9-31). [emphasis added].

Thus, in superplastic forming, differential gas pressure causes a heated sheet to flow into the shapes of the die cavity. This differs from "die pressing," which the Examiner equates with machining. As is well understood in the art, die pressing refers to an operation in which a male punch and female die are pressed together to form a hole in a workpiece or deform the workpiece in some desired manner. The die is typically held stationary, while the punch is attached to the end of a moveable ram.

Contrary to the Examiner's assertion, superplastic forming does not merely refer to the state of the material during processing. Instead, superplastic forming refers to the process of applying differential gas pressure on either side of a heated sheet to be formed. As such, the skilled artisan would recognize that superplastic forming is clearly different from die-pressing.

Therefore, contrary to the Examiner's assertion, it would not have been obvious to "remove excess metal from the workpiece after the die pressing in the process of Lederich" because there is no die-pressing operation in Lederich.

Furthermore, Applicants submit the Examiner's proposed combination of the teachings of Lederich, Zwicker, and Beall is improper. While it is true that Beall discloses removing excess metal from a gear by grinding or machining, the removing excess by grinding or machining is performed after a die-pressing operation, not after a superplastic forming operation (as in Lederich). As such, there is no identifiable reason for adding a metal-removing machining step to the process of Lederich.

For all of the above-noted reasons, Applicants submit that no proper combination of the applied art discloses or teaches all of the invention recited in claim 1. As claims 2, 5, 7, 8, 10, and 11 depend from independent claim 1, these claims, too, are distinguishable from the applied art at least for the reasons discussed above. Claims 3, 6, and 16 are canceled, thereby rendering the rejection of these claims moot. Moreover, the applied art fails to disclose or suggest many of the features recited in the dependent claims.

For example, claim 7 depends indirectly from independent claim 1, and additionally recites the vacuum is at least $2 \cdot 10^{-3}$ Pa. The Examiner admits that Lederich is silent regarding a quantitative value of the vacuum pressure, but asserts that the claimed invention would have been obvious in view of Zwicker's teaching of a "high vacuum". Applicants respectfully disagree.

Zwicker, like Lederich, fails to disclose or teach a quantitative value of the vacuum pressure. The phrase "high vacuum" is a relative term, and in no way teaches a vacuum of at least $2 \cdot 10^{-3}$ Pa. At page 13 of the Office Action, the Examiner acknowledges that none of the applied art discloses this feature, but asserts that such a feature would have been obvious. Applicants disagree with this factually unsupported assertion, and submit that the Examiner is improperly

resorting to speculation, unfounded assumption or hindsight reconstruction to supply deficiencies in the factual basis for the rejection.

Accordingly, Applicants respectfully request that the §103 rejection of claims 1-3, 5-8, 10-11, and 16 be withdrawn.

Claims 4, 9, 12-14, and 17-20

Claims 4, 9, 12-14, and 17-20 are rejected under 35 U.S.C. §103(a) as being unpatentable over Lederich and Zwicker, and further in view of various additional combinations using references: Smickley, Garg, Fisher, Borowik, and Whang. These rejections are respectfully traversed.

Claims 4, 12 and 17-20 are canceled, thereby rendering the rejection of these claims moot. Claims 9, 13, and 14 depend from allowable independent claim 1, and are allowable at least for the reasons discussed above with respect to claim 1. That is to say, Lederich and Zwicker (and Beall) fail to disclose or suggest the combination of features recited in claim 1, including *inter alia*: *cooling of the workpiece* and *metal-removing machining of the workpiece*. None of the other applied references (e.g., Smickley, Garg, Fisher, Borowik, and Whang) cure the deficiencies of Lederich and Zwicker (and Beall) with respect to independent claim 1, because none of these references teach *cooling of the workpiece* and *metal-removing machining of the workpiece*. Therefore, no proper combination of the applied art discloses or suggests all of the features of independent claim 1, and claims 9, 13, and 14 that depend therefrom.

Accordingly, Applicants respectfully request that the §103 rejection of claims 4, 9, 12-14, and 17-20 be withdrawn.

Claim 25 in view of Lederich, Zwicker, Beall, Whang, and Matsuo

Claim 25 is canceled by this amendment, thereby rendering the rejection moot. Accordingly, Applicants respectfully request that the §103 rejection of claim 25 be withdrawn.

Claims 21-24 in view of Matsuo

Claim 21 is amended to recite:

> 21. An alloy for producing a workpiece made from a titanium-based alloy, comprising TiAl6V4 having a lanthanum content of 0.3 – 1.5 atomic%,
>
> wherein the lanthanum is nearly completely precipitated into precipitates of pure lanthanum devoid of oxygen and nitrogen,
>
> the precipitates having a mean size of 12 μm,
>
> a distribution of the precipitates is restricted to grain boundaries and a grain interior between dendrites and a cast microstructure.

Applicants submit that no combination of the applied art discloses or suggest this combination of features. First, contrary to the Examiner's assertion, Matsuo does not disclose or suggest an alloy comprising TiAl6V4. Instead, Matsuo disclose an alloy defined by:

$Ti_{100\text{-}x\text{-}y}M1_{x}M2_{y}$

where M1 can be V, M2 can be Al and La, and in which x+y is 20 to 80 atomic%. Applicants submit that this formula does not include TiAl6V4 having a lanthanum content of 0.3 – 1.5 atomic%, as recited n the claimed invention. This is because in TiAl6V4, where M1 is Al6 and M2 is V4, the value of x+y is about 88 atomic%. The addition of 0.3 – 1.5 atomic% of lanthanum would not bring the x+y value within Matsuo's range of 20 to 80 atomic%. Since TiAl6V4 having a lanthanum content of 0.3 – 1.5 atomic% does not have an x+y value between 20 to 80 atomic%, Matsuo cannot be said to disclose TiAl6V4 having a lanthanum content of 0.3 – 1.5 atomic%, as recited in claim 21.

In any event, Matsuo does not disclose or suggest: *the lanthanum is nearly completely precipitated into precipitates of pure lanthanum devoid of oxygen and nitrogen, the precipitates having a mean size of 12 μm, or a distribution of the precipitates is restricted to grain boundaries and a grain interior between dendrites and a cast microstructure*, as further recited in claim 21.

Therefore, Matsuo does not disclose or suggest all of the features recited in claim 21, and does not render the claimed invention obvious. Claims 22 and 24 are canceled by this amendment, thereby rendering the rejection of these claims moot. Claim 23 depends from claim 21, and is allowable for at least the reasons discussed above with respect to claim 1.

Accordingly, Applicants respectfully request that the §103 rejection of claims 21-24 be withdrawn.

Claim 26 in view of Lederich, Beall, and Fisher

Claim 26 is amended to recite:

> 26. A method for machining a workpiece made from a titanium-based alloy, comprising:
> removing at least one of surface oxides and further covering layers from the workpiece;
> after the removing, heating the workpiece in a hydrogen-containing atmosphere to an annealing temperature of at least 773 K, during which the workpiece takes up hydrogen, wherein the hydrogen-containing atmosphere is under a pressure of approximately 5×10^3 Pa;
> after the heating to the annealing temperature, cooling the workpiece in the hydrogen-containing atmosphere;
> after the cooling, metal-removing machining the workpiece; and
> after the machining, heating the workpiece in a hydrogen-free atmosphere, wherein the hydrogen is released.

Applicants submit that no proper combination of the applied art renders claim 26 obvious. As discussed above with respect to claim 1, no proper combination of the applied art discloses or suggests the combination including, inter alia, *cooling the workpiece in the hydrogen-containing atmosphere, and metal-removing machining the workpiece.* Even further, Applicants submit that no proper combination of the applied art discloses the steps of claim 26 *in the order recited.*

Accordingly, Applicants respectfully request that the §103 rejection of claim 26 be withdrawn.

New claims

New claims 27 and 28 are added by this amendment, and are believed to be distinguishable at least based upon its inclusion of the features of independent claims 1 and 21, respectively.

Canceled claims

Claims 3, 4, 6, 12, 16-20, 22, 24, and 25 are canceled without prejudice or disclaimer. Applicants are not acquiescing that any proper combination of the applied art renders these claims unpatentable. Applicants expressly reserve the right to file the subject matter of one or more of these claims in one or more continuing applications.

CONCLUSION

In view of the foregoing amendments and remarks, Applicants submit that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicants hereby make a written conditional petition for extension of time, if required. Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 19-0089.

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